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Recyclable Materials in Food Service Facilities and Energy Recovery Possibilities

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To the Graduate Council:

I am submitting herewith a thesis written by Mary E. Kopp entitled "Recyclable Materials in Food Service Facilities and Energy Recovery Possibilities." I have examined the final electronic copy of this thesis for form and content and recommend that it be accepted in partial fulfillment of the requirements for the degree of Master of Science, with a major in Food Science and Technology.

Mary Jo Hitchcock, Major Professor

We have read this thesis and recommend its acceptance:

Harold W. Henry

Accepted for the Council:
Dixie L. Thompson

Vice Provost and Dean of the Graduate School

(Original signatures are on file with official student records.)

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Accepted for the Council:

L. Evans Roth

Vice Chancellor
Graduate Studies and Research

RECYCLABLE MATERIALS IN FOOD SERVICE FACILITIES AND ENERGY RECOVERY POSSIBILITIES

A Thesis

Presented for the

Master of Science

Degree

The University of Tennessee, Knoxville

Mary E. Kopp

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ABSTRACT

An identification of recyclable materials in food service facilities with potential energy recovery possibilities was determined by a mail questionnaire and on-site observations/interviews of food service facilities. Thirteen hospital food service departments, twenty-four restaurants, and eighteen combined hospital food services and restaurants responded to the questionnaire entitled, Current Energy Practices and Possibilities for Recycling of Materials in Food Service Facilities. Five facilities--two hospital food service departments and three restaurants--participated in the observations to examine actual practices of energy recovery through recycling processes. A second purpose of the study was focused on identifying the recycling method with approximate costs and benefits.

Energy recovery through recycling or reusing food production materials was not widely practiced, due to the unattractive payback period relative to current energy usage and charges. It was found that grease products were the most frequently recycled material in both types of food service facilities via the sale of these waste products to a commercial fat rendering company. Glass products were reused. Food trimmings and overproduction of food were generally reused in soups, casseroles, and stews. The

recycling of paper, plastic, styrofoam, metal, liquid food waste, heat, and water was not used.

Correlations were made between the types of energy recovery methods considered to produce a cost savings, and the types of energy conservation measures presently used in these food service facilities. Most respondents indicated potential recovery possibilities through methods of recycling heat from cooking and refrigeration equipment, dishmachine, air conditioning and other systems; and its link to reducing energy consuming activities as a conservation measure.

Recommendations for energy conservation opportunities through recycling or reuse of food production materials were suggested as potential solutions to the energy situation.

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CHAPTER 1

INTRODUCTION

The United States' Department of Energy has developed new strategies within its National Energy Plan during 1981 designed to reduce the waste of energy. Energy wasting elements of industry include inefficiencies of equipment operation, maintenance, and design. A proposal from the 1982 administration of the United States is to return the business of energy development, production, and conservation to the private sector. The administration proposes to eliminate burdensome regulatory programs. It supports funding in high risk research and development for solar and other renewable resources. It endorses high payoff research and development projects directed at conservation. Among these are recovery systems designed to recapture and reuse waste products for fuel (Edwards, 1981).

Our future energy demand will be primarily met with conventional sources; namely, coal, oil, and natural gas. The use of hydropower, geothermal power, solar power, and biomass fuel systems will become target resources over the next two decades. Synfuels offer a longer term solution to U.S. energy needs (Edwards, 1981).

The immediate challenge is to face the realities of our energy flow. The realities mean looking at the present operational needs with existing equipment and systems, exercising conservation opportunities where possible, and developing new energy sources to ease or reduce the dependence on coal, oil, and natural gas.

Conservation continues to offer the greatest prospect of reducing energy consumption, costs, and meeting environmental goals. The food industry, particularly the food processing and food service segments, is in a good position to reduce its energy usage through conservation and implementation of energy recovery systems.

In 1976 the Federal Energy Administration estimated that energy consumed by the U.S. food system, excluding exports of food products, amounted to 16.5 percent of total energy requirements (Anon., 1976). Since 69 percent of all energy consumed by the food processing segment of the industry comes from natural gas and oil, the industry is looking at ways to recover wasted energy through process steam and heat exchange (Anon., 1981a). In most recent years the food processing industry has provided evidence showing the efficient use of energy through recovery systems.

The food processing industry has emerged with energy recovery methods in the last decade due to the energy crisis. Yet, natural gas remains its chosen fuel source. As future supplies of coal, oil, and natural gas diminish and their costs increase, the outcome for food processors means an application of conservation measures, price adjustments in goods produced, and development of recovery systems for efficient use of energy.

The food processing industry is pioneering new technologies to use renewable energy sources as alternate fuel bases, and thereby, reduce its demand for coal, natural gas, and oil. A reduced demand for these renewable sources has achieved advancement in the conservation of energy and materials unique to the food processing industry. In light of this progress, however, the food service sector has provided no detailed statistics on a national level comparable to those for food production and processing (Unklesbay and Unklesbay, 1980a).

Application of this technology can be made to the food service industry which is suffering a technological and procedural lag in conservation of energy and materials (Murphy, 1978). A recent investigation of energy usage in food service operations showed that food preparation and storage areas utilize nearly one-half of all the energy consumption for those institutions. Dishwashing and sanitation utilizes 13 percent of the total energy (Anon., 1980a). Another report found the energy use in food production and storage areas to be 26 percent of the total energy consumption and 38 percent of total energy cost (Anon., 1980a).

The energy crisis continues to be a paramount issue in our technological society. The issue is concerned with the available supply, sources, forecasted demand, and cost. Faced with the cost of energy rising constantly, the accurate control and management of energy as well as reductions in usage and costs have become top priorities for food service operators (Anon., 1981a).

There are obvious considerations to be made about the food service industry and its responsibility to the energy crisis. First is a change in the market form of food that has taken place over the last decade. The emphasis is on prepackaged, conveniently wrapped items in nonreturnable, disposable containers to meet the demands of the food service industry. Efficient utilization of resources, production, and service is a means of achieving these goals through the purchase of convenient market forms of food, energy-efficient equipment, and changes in production methods and service.

Advancement has been made toward efficiency and conservation in the food service industry. Technological change in the market form of food, high speed, automatically-timed cooking and ware-washing equipment has moved the industry toward operational efficiency and energy conservation. Yet, the food service industry remains unique in the manufacture of perishable products that generate many forms of waste by-products in large volume. These by-products have the potential for conversion into fuel.

The literature is well-documented with the energy conservation efforts accomplished by this industry. Documentation exists for the percentage of energy consumption used by food production areas in food service facilities. There is little evidence, however, on the recovery of energy through recycling or reusing waste products as a subsidiary fuel source in the food service industry. Confirmation of the available research was obtained from a computer search using the ABI and Agricola data bases.

Reduction of energy consumption and waste in food services can be accomplished through various conservation and recovery methods. Present knowledge in the food service industry gives little evidence of investigation into fuel from waste products. Due to this lack of knowledge, an investigation of conservation and energy recovery from waste products in food service facilities is warranted.

The purpose of this research was to conduct an investigative inquiry into the potential for recovering energy through recycling or reusing waste products in food service facilities.

The objectives of the research were:

1. To determine whether, and to what extent, recycling of food production waste products existed in food service facilities.

2. Where recycling existed, identify the methods with approximate costs and benefits.
3. To make recommendations for energy conservation measures through recycling or reuse of these products.
4. To make a contribution to the literature in the field of food systems administration.

CHAPTER 2

REVIEW OF LITERATURE

Resources, availability, and demand for energy in the food service industry are major factors affecting supplies and operational costs. Despite attempts to spur domestic exploration and production, most of the world's oil is controlled by OPEC. The United States' proven energy reserves and production have actually declined since the early 1970's (Jensen, 1979). The short-term objectives of the American energy policy are obvious. As an immediate objective, which will become more important in the future, the United States must reduce its dependence on foreign oil and its vulnerability to supply interruptions (Ashton, 1979). In mid- and long-term objectives, the United States must shift to more secure energy sources with strong consideration to renewable sources (Jensen, 1979).

The new focus at the Department of Energy includes, among other strategies, the funding of high risk research and relegating the responsibility of development for solar and other renewable energy sources to the private sector. There is a shift to fund high risk, high payoff research and development projects directed at conservation (Edwards, 1981). Overall, the main goal is to increase domestic energy development and production.

Energy Supply

Mechanical energy, in the form of electricity, natural gas, and steam, is primarily fueled by nonrenewable sources at the present time in the food service industry. In 1973, 48 percent of the energy used was derived from natural gas. Purchased electricity was second in importance, with about 28 percent of the total gross energy coming from this source. The third most important energy source was coal, with about 9 percent of the gross energy utilized (Unger, 1975).

Other sources of energy, classified as renewable forms; that is, hydropower, geothermal power, solar power, and biomass fuel systems, will become target resources over the next two decades. Continued practices of energy conservation will be encouraged to reduce fuel consumption, and maintain or reduce costs. Heat recovery methods and systems in food service production areas offer other opportunities.

Hydropower, solar power, and biomass fuel systems may or may not be available, cost-effective opportunities for the food service industry. Some of these renewable sources are large in extent, but generally diffuse in form, and more difficult and expensive to convert to usable mechanical and thermal energy than fossil fuels (Loftness, 1978). A conversion to renewable energy sources is not a simple matter (Loftness, 1978). The costs involved with conversion must be realistic and affordable to the food service industry to effect an acceptable cost-benefit ratio in reduction of energy use.

A proposal from the 1982 administration of the United States is to return the business of energy development, production, and conservation to the private sector. The administration proposes to eliminate burdensome regulatory programs (Edwards, 1981). This restructure of decision-making power will heavily affect the source of supply, demand, and cost for conventional fuel sources; namely, coal, oil, and natural gas.

Supply, demand, and cost of these nonrenewable fuel sources are subject to management control in the food service industry. Food service directors and restaurant managers need to consider immediate alternative solutions to the diminishing supply of energy sources, rising demand for these sources, and wasteful habits they encounter in their facilities.

Energy Conservation in the Food Service Industry

Careful examination of energy usage patterns through energy audits and equipment monitoring can reveal areas of waste. One of the studies of energy management in the food service industry conducted by the Midwest Research Institute indicated the following breakdown of energy consumption for a general restaurant menu: food preparation; heating; ventilation and air conditioning; sanitation; lighting; and refrigeration (Welch, 1974). Major concerns reported by food service operators were cost and availability of energy (Sant, 1976).

Cost and availability of the nonrenewable energy sources are subject to escalation and diminishing supplies, respectively. During the past two decades there has been an increasing tendency for industry and transportation to become more energy intensive (Dorf, 1978). The food service industry is considered energy intensive. It consumes large amounts of energy, and loses an undetermined amount through waste heat and production waste materials. A research project conducted at Purdue University reported that only 40 percent of the energy going into the average kitchen was used for cooking the food. The other 60 percent was absorbed by the equipment or ventilated out the hood (Avery, 1974).

While there is little information available concerning the energy lost through food waste in the United States, it appears that energy can be conserved through improved production, handling, and preparation practices in every sector of the food service system (Romanelli, 1976).

Development of conservation techniques is considered the first step to assist in relieving the concerns for cost and availability of energy (Romanelli, 1976). Conservation is the development of energy systems that require low cost energy input with efficient energy output, and the elimination of wasteful habits. It is a demonstration of ways to get a greater return from energy resources. Research and technology exists to provide alternative methods for efficient fuel use at a cost that food service industry can afford.

Conservation continues to offer the greatest prospect of reducing energy consumption, costs, and meeting environmental goals. Reduction and efficient use of energy requires permanent changes under the stimulus of rising energy prices (Foley, 1981). Statistics show that the average food service operator now spends 5 percent or more of his or her gross sales on energy (Anon., 1980a). Energy can generate a cost savings by practicing conservation measures, such as, monitoring lighting wattage and consumption of cooking gas, checking pipes and outlets for steam loss, and maintaining heating, air conditioning, refrigeration, and ventilation systems for efficiency (Anon., 1980a).

The whole scheme of energy conservation and recovery opportunities in the food service industry is complex. The opportunities are affected by costs, resources, traditional food production systems, and the compromises existing with each one of these factors.

The immediate challenge is to face the realities of our energy flow. One reality is looking at the present operational needs with existing equipment and systems. Another important factor in assessing energy use is to subdivide or segment food processing and food service production areas in order to account for primary differential energy requirements within the industry (Unger, 1975).

Each area has unique energy-use characteristics that requires thorough examination for energy recovery possibilities. The new administration of the Department of Energy endorses high payoff recovery systems designed to recapture and reuse waste products for fuel (Edwards, 1981).

One of the important lessons that has been learned from the past decade's experience is that energy demand cannot be aggregated and forecasted as though it were an entity independent of the sources by which it is supplied (Foley, 1981). The realization that 69 percent of all energy consumed by the food processing segment of the industry comes from natural gas and oil illustrates that three-fourths of the energy demand is supplied by finite or nonrenewable energy sources (Anon., 1981b).

Resources that hold promise of supply to the food service sector include geothermal power, nuclear power, solar power, biomass systems, and synfuels. However, the amount of these resources and conversion-production technology is presently cost prohibitive to the food service industry (Loftness, 1978).

Faced with the cost of energy rising constantly, the accurate control and management of energy as well as reductions in usage and costs have become top priorities for food service facilities (Anon., 1981a). Yet, curtailing production practices or restricting services to patients and guests are considered genuine predicaments by food service directors and restaurant managers. Effective management in food service facilities requires (a) discriminating information about energy use for food service equipment and production areas, and (b) a basic understanding of energy concepts in order to anticipate the effects of change in energy management policy (Unklesbay and Unklesbay, 1980b).

A recent investigation of energy usage in food service facilities showed that food preparation and storage areas utilize nearly one-half of all the energy consumption for those institutions (Anon., 1980a). The preparation of food within food service facilities is totally dependent on the availability of suitable forms of energy. At least 50 percent of energy expenditures within food service departments are for food preparation; a considerable portion of this energy is used to heat the environment instead of the food (Unklesbay and Unklesbay, 1980b). Research is beginning to show that traditional methods of food preparation are not only energy-intensive, but they also waste large amounts of energy.

There is no short-term solution to our energy situation. It can be resolved only by a concerted effort applied over a substantial period of time (Unklesbay and Unklesbay, 1980b).

Energy from Waste Materials

Energy conservation is the immediate palliative solution to the energy situation in food service systems. Discovery of alternative conservation methods lies in the awareness of recapturing energy from waste materials in food service production areas. These waste materials include paper, containers, wood, tin cans, aluminum products, food trimmings, and so on. At the present time most of this waste is relegated to the land fills and garbage dumps at the outskirts of cities and towns (Dorf, 1978).

According to Dorf (1978) waste products can be used to provide fuels for electric power and steam plants. It has been estimated that 50 to 60 percent of these types of waste are combustible. More importantly, the recycling of metals, plastic, paper, glass, and wood conserves energy since more energy is consumed in the original manufacture of these materials than is consumed in the recycling process (Dorf, 1978).

Efforts to recover energy from solid waste can be classified in three distinct schemes: (1) direct heat recovery from special incinerators; (2) supplementary fueling of power plants with waste material; and (3) conversion of the waste to synthetic fuels (Dorf, 1978). Application of these recovery methods using waste materials from food production can be seen as an alternative conservation opportunity to the food service industry.

Recycling and Reuse of Waste Materials

Few industries create so much waste as that which arises in the production of food. Much of this waste is due to the exceptionally high standards of quality that exist within the food industry which has to meet the most exacting standards and specifications in providing products which the consumer has come to expect as normal (Walker, 1979).

The Government is exploring alternate energy sources for certain food processing industries such as utilization of on-site fuel cell power plants with waste heat recovery (Glass, 1978). Glass (1978) continues by stating that partial recycling of the exhaust stream reduces the volume of fresh makeup air required by the system, thus, overall energy requirement is reduced. Waste heat from air or refrigeration compressors can be utilized by preheat boiler compression air and heat process hot water in food production areas (Glass, 1978).

Economic Incentives

Economic incentives in previous years have failed due to a lack of technological advancement in the area of recycling and reclamation (Gottschalk, 1980). Increasing the economic aspects for recycling and reclamation are becoming more attractive as energy availability becomes threatened (Gottschalk, 1980). Murphy (1978) states the determinants for a successful recycling program in the hospitality industry must be extraordinarily simple, non-time consuming, and at no additional capital expense to the operator. Heat reclamation is already cost effective as a recycling method and will probably continue to be prevalent in hospitality operations.

Many benefits accrue from recycling of waste materials in food service facilities. Murphy (1978) identified these benefits as: lower waste disposal costs through waste reduction; extra income through the sale of recyclable materials; and reduced energy costs through heat recycling.

A strong awareness of the energy situation, as it concerns food service directors and restaurant managers, is necessary in the development of alternative solutions for our energy needs. Technical innovations and energy-efficient equipment research are a part of the solution. However, the total picture requires an assessment of current and long-range needs, and a responsive commitment to the alternative solutions.

CHAPTER 3

PROCEDURE

Evaluating energy alternatives for food service systems demonstrated the realization that present energy sources were nonrenewable, and options were necessary to conserve and recover energy from waste materials. Recovering energy through the recycling process has been existent in the related fields of food engineering, food processing, and food packaging for several years.

This study surveyed hospital food service departments and restaurants to determine the potential for recovering energy through recycling or reusing waste products in food service facilities. An identification of recycling methods with approximate costs and benefits was made in selected facilities.

Development of Questionnaire

A questionnaire was developed to obtain energy recovery and waste material recycling information from hospital food service departments and restaurants in the state of Tennessee. The questionnaire was field tested to ensure its validity and reliability. Suggestions for improvement of the questionnaire were solicited as a part of the preliminary process.

Design and Content

Time consideration of the respondents was a major criterion in the overall composition of the questionnaire. Question format was designed for easy comprehension, concise and brief answers, and rapid return rate. Fourteen questions were constructed with multiple choice and open blank answers. The questions covered four broad areas of energy recovery and waste material recycling possibilities. Areas included type and cost of energy used, type and form of foods purchased, type of waste materials and method of recycling or disposal, and energy recovery and conservation measures utilized in the food service facility plus the effect of conservation measures on various phases of operation.

Field Test

Validity and reliability of the questionnaire were established by personal interview with two registered dietitians and two restaurant managers located in Rock Island and Moline, Illinois. Comments and suggestions were solicited for initial response, interpretation, and clarification of the questionnaire by personal interview with two registered dietitians and two restaurant managers located in Rock Island and Moline, Illinois.

Revision of Questionnaire

Upon receipt of the dietitians' and restaurant managers' suggestions, the researcher reformulated parts of the questionnaire to encourage a high rate of return from the mail survey. The final questionnaire incorporated the elements of strict confidentiality, a willingness to respond, easy interpretation of questions, and clarity of answers (see Appendix B).

Identification, Selection, and Classification of the Food Service Facilities

The process of identifying and selecting hospital food services and restaurants in Tennessee was achieved through a guide book publication and public listings of these facilities. Classification was determined by answers to the seating capacity question listed on the mail questionnaire.

Sources

Identification of hospital food service departments was obtained from the American Hospital Association's Guide to Health Care Institutions. Telephone directory listings for restaurants provided the names, addresses, and telephone numbers of the restaurant population.

Classification and Size

Preliminary decisions were made to limit the survey to hospital food service departments and restaurants. Bed size in the hospitals, and seating capacity of dining areas in hospital food service departments and restaurants served as criteria for classification and size. Classification was defined as medium and large. Medium and large hospitals were set at 150 to 250 beds and greater than 250 beds for respective classes. Medium and large restaurant dining areas were estimated at 75 to 125 seats and greater than 125 seats for respective classes.

Sample Selection

Sixty-one hospital food service departments representing the population of medium and large hospitals in Tennessee were selected to be a part of the survey. Through use of a random numbers table, a selected sample size of one hundred restaurants was taken from the restaurant populations in Memphis, in Nashville, in Chattanooga, and in Knoxville, Tennessee. These four hundred restaurants were included in the survey.

Data Collection

A mail questionnaire was chosen to collect data on current practices and possibilities for energy conservation through recycling of waste materials in food service facilities. A cover letter explaining the project was addressed to each director of dietetics and restaurant managers in the sample. A questionnaire and stamped, self-addressed return envelope accompanied the cover letter (see Appendix B).

Observation of Energy Recovery and Conservation Opportunities

To examine actual practices of energy recovery and conservation through recycling processes, a check list instrument and cost analysis forms were developed for on-site observations of hospital food service departments and restaurants (see Appendix B). A team consisting of the researcher, professor of food systems administration, and mechanical engineering student conducted the examination of recycling practices in selected food service facilities. An estimated cost-benefit analysis was determined by the researcher based on the team's input.

Selection of Food Service Facilities

Selection of food service facilities was based on response to a question from the mail questionnaire indicating a willingness to have the hospital food service or restaurant surveyed. A total of seventeen hospital food services and restaurants indicated a willingness to have their facility surveyed. Two hospital food service directors and three restaurant managers of the chosen facilities were contacted, and arrangements were made for the on-site observation and interview.

Check List Technique

Identification of recycled versus nonrecycled waste materials was accomplished by a check list instrument. The categories consisted of major waste materials followed by detailed subcategories of each major area (see Appendix B). A check mark was placed in the appropriate column upon observation and questioning of the director or manager of the facility.

Waste Material Tracking Experience

Tracking of recyclable food service materials was done by disclosure of material type and description, beginning and ending location, method of transportation and recycling, estimated volume removed each day, and the type of energy used in the process. Information was obtained by direct observation and interviews with food service personnel.

Estimated Cost Analysis

Direct and indirect costs of recycling waste materials in food service facilities were estimated on a basis of total raw food cost, percentage of raw food waste, and cost applied to waste removal. Direct costs were divided into direct labor, food waste, nonfood waste, transportation and holding containers, and packaging materials and supplies. Indirect costs considered the maintenance and repair of equipment, cleaning and sanitation of equipment, storage space required, training of personnel, and other supplies. Information was obtained from the directors and managers at each facility.

Analysis of Data

The analysis of data consisted of a computerized tabulation of responses from the mail questionnaire. The tabulation program determined the percentage of responses to the questionnaire and frequency distribution among hospital food service departments and restaurants. The Product Moment Correlation technique was used to ascertain the correlation between waste generation, recycle and recovery methods, and cost-benefit association in hospital food services and restaurants.

A tally of the check list responses, obtained from the on-site visits, was analyzed by hand to determine the percentage of waste materials presently being recycled or not recycled in these facilities. The data from the waste material tracking experience was analyzed by direct and indirect costs as defined in the procedure.

Based on these findings, recommendations for least cost and greatest cost to energy conservation opportunities were suggested as possible energy alternatives for the food service industry.

CHAPTER 4

RESULTS AND DISCUSSION

A mail questionnaire was developed to obtain energy recovery and waste material recycling information from sixty-one hospital food service departments and four hundred restaurants in the state of Tennessee (see Appendix B). The second segment of the study required on-site observations of two hospital food service departments and three restaurants in Knoxville to ascertain actual energy recovery and/or recycling practices in the field. A check list and tracking of recyclable and reusable waste materials instrument were used for data collection at each site (see Appendix B). Data collection from the site visits was used in conjunction with the computerized output from the mail questionnaire to analyze practices and methods for recycling food production waste products in food service facilities, and to identify approximate costs and benefits of the methods.

The Mail Questionnaire

Four hundred and sixty-one questionnaires were sent to hospital food service departments and restaurants in Memphis, Nashville, Chattanooga, and Knoxville, Tennessee. A total of fifty-five questionnaires, or 11.9 percent, were returned.

The Questionnaire

The type of food service was identified from the questionnaire as (1) hospital food service department, (2) restaurant, and (3) unknown, representing a mixture of hospital food services and restaurants. The questionnaire entitled, Current Energy Practices and Possibilities for Recycling of Materials in Food Service Facilities, was divided into waste generation, energy recovery and recycling, and cost/benefit classifications.

Type and Size of Facility

From the returned questionnaires, the frequency and distribution of food service facilities were based on thirteen hospital food service departments, twenty-four restaurants, and eighteen "unknown" food service facilities representing unidentified hospital food services and restaurants. Approximately 32 percent of the returned questionnaires gave no identification to the type of facility. The identification of the remaining 68 percent was gained from those who were willing to participate in the on-site surveys.

Seating capacity data provided background information on the facility's size. The size gave some indication of the relative volume of food production (see Table 1, Appendix A). Food service facilities with greater than 150 seats denoted the highest percentage in seating capacity for the three classifications. The second highest seating capacity was identified as the fifty to ninety-nine seating range for hospital food services, restaurants, and the unknown group. The 100 to 149 seating capacity placed third in frequency and percentage of size. Facilities with less than fifty seats showed no significant representation.

The food service facilities with greater than 150 seats had an empirically greater potential for producing a large volume of waste through food production practices than facilities with smaller seating capacities. The remaining facilities were subject to varying amounts of potential waste volume based on factors, such as, paper and styrofoam products used in service; and the use of convenient market forms of food in production.

Waste Materials and Removal Methods

An analysis of food purchased by hospital food service departments and restaurants indicated that 50 percent of the food purchased was frozen, 30 to 49 percent canned, 10 to 29 percent fresh. The least purchased food was the dried variety at less than 10 percent (see Table 2, Appendix A).

The market form of food purchased showed that individually wrapped foods were most frequently purchased by hospital food services followed by bulk and pre-portioned market forms. Restaurants showed little variation in the purchasing frequency of bulk, pre-portioned, and individually wrapped foods (see Table 3, Appendix A). Paper wrappers, cellophane, and plastic containers were the primary waste materials generated by these market forms of food. The "unknown," or unidentifiable, group of food service facilities indicated little variation in purchasing frequency.

In relation to possible recycling or reuse of materials, all responses showed a potential for recycling or reuse of either the food itself or the packaging container.

To follow the course of recycling or reuse of materials, the mail questionnaire helped to identify the type of tableware used in hospital food services and restaurants as an indicator of recyclable waste materials. Responses from the questionnaire showed that 100 percent of the hospital food services used china, glassware, and stainless steel utensils. No indication was given on the percentage of paper, plastic, styrofoam cups, paper plates, and napkins used in these facilities. The restaurants showed that 68 percent used china, glassware, and stainless steel utensils with 29 percent usage of paper, plastic, styrofoam cups, paper plates, and napkins. The "unknown" group identified a 50 percent usage rate for each classification of tableware (see Table 4, Appendix A).

An indirect assessment of recyclable materials from waste materials was gained from the responses to the mail questionnaire. The classification of recyclable materials was limited to paper, plastic, styrofoam, metal, glass, solid food waste, liquid food waste, grease, heat, and water. Hospital food services indicated that 100 percent generated waste materials from styrofoam, metal, glass, heat, and water. Approximately 8 percent of the remaining waste materials, such as, paper, plastic, solid food waste, liquid food waste, and grease products were found in hospital food services. Restaurants showed that paper products, styrofoam products, solid food waste, and grease products were the primary waste materials found in these facilities. Metal, heat, and water waste products showed a 4 percent higher average over plastic products found in restaurants. Glass products and liquid food waste were found in 79 percent of the restaurants (see Table 5, Appendix A). The unidentifiable group of hospital food services and restaurants indicated that grease products were the primary waste materials. Paper, plastic, styrofoam, and heat waste products were identified as waste materials by 94 percent of these facilities (see Table 5, Appendix A). Potential recyclable materials totaling 6 percent existed in the remaining classifications; namely, solid food waste, water waste products, glass products, and liquid food waste.

Identification of waste removal methods used by hospital food service departments and restaurants provided an indication of the current practice of recycling waste materials with energy recovery.

Hospital food services showed that 100 percent of these facilities used a commercial disposal service to remove waste materials. The method of incineration was indicated by 31 percent. Recycling waste materials was identified by 8 percent of the hospital food service departments. Restaurants denoted that 100 percent of these facilities used a commercial disposal service to remove waste materials. There was no representation for the incineration process in restaurants (see Table 6, Appendix A). The recycling process was identified as a waste removal method in 8 percent of these facilities. The "unknown" group of hospital food service departments and restaurants disclosed that 94 percent of these facilities used a commercial disposal service, 11 percent used an incineration process, and 17 percent denoted recycling as a method of removing waste materials (see Table 6, Appendix A).

Energy Sources and Costs to Facilities

The types of energy presently used in food service facilities are electricity, natural gas, oil, and steam (Unger, 1975). These types of energy are produced from nonrenewable sources. An assessment was made of the rank, frequency, and percentage for each energy type (see Table 7,

Appendix A). Electricity was ranked number one as the primary source of energy. Natural gas was the second source followed by "other" types which represented handwritten comments on energy, water, and sewage cost rates. Steam was last in rank.

Results from the mail questionnaire showed that twelve of the thirteen, or 92 percent, of the hospital food service departments were not directly charged for energy usage. One facility, representing 8 percent, was directly charged for energy usage (see Table 8, Appendix A). Electricity was the primary type of energy used in hospital food services. Natural gas and steam were equally represented as the secondary type of energy used.

The computer analysis disclosed that twenty, or 83 percent, of the restaurants were directly charged for energy usage. Three, or 13 percent, of these facilities were not directly charged. One facility, representing 4 percent, had not answered the question regarding energy charge rates. Restaurants denoted that 79 percent used electricity as the major type of energy. Natural gas was indicated by 46 percent of these facilities to be the secondary type of energy used. Under the category of "other" types of energy, 15 percent of hospital food service departments provided handwritten answers explaining the dollar costs for energy, water, and sewage service charges to the facility; 25 percent of the restaurants provided handwritten answers explaining their costs, and 28 percent of the "unknown" food service facilities indicated dollar amounts reflecting their average monthly energy costs (see Table 9, Appendix A).

The "unknown" group of hospital food services and restaurants showed that 50 percent were directly charged for their energy use. Fifty percent indicated they were not directly charged. Six of the facilities, representing one-third of the "unknown," disclosed that electricity and natural gas were the two most frequently used types of energy. The classification of "other" types of energy represented 28 percent of the energy used by the "unknown" food service facilities. These respondents provided handwritten answers reflecting their average monthly fuel bills (see Table 9, Appendix A).

A range of average monthly energy costs, from a low of $15.00 to greater than $2551.00 per month, for hospital food service departments and restaurants was determined from the handwritten information supplied on the returned questionnaires. Table 9, Appendix A, shows the number of facilities and range of energy charges according to the type of energy used.

Thirty facilities provided dollar information for their average monthly energy charges. Electricity was the most prevalent type of energy charged to the facilities. The greatest frequency occurred in the $150.00 to $450.00 range. The next highest frequency was in the $751.00 to $1,050.00 range. The third greatest frequency was found in the $1,151.00 to $2,050.00 range. Natural gas, the second existing type of energy charged to the facilities, denoted a large frequency in the $151.00 to $450.00 range. A smaller frequency fell in the range of $15.00 to $150.00 per month (see Table 9, Appendix A).

Reasoning for low energy costs and frequencies revealed three speculations. One speculation indicated that hospital food service directors and restaurants managers lacked an accurate knowledge of actual energy charges. The second speculation was that these facilities practiced several conservation measures which enabled them to keep their energy costs low. The third speculation was based on the possibility of reduced service hours which may have contributed to lower energy use. The higher ranges of energy costs and frequencies were interpreted as an indication of energy-intensive equipment use and/or continual, 24 hour, service.

Energy Recovery Methods as a Cost Savings

Hospital food service directors and restaurant managers were asked on the mail questionnaire to indicate which energy recovery methods would be a cost savings to their fuel bills. This disclosure was a contributory factor in assessing the current energy perception among food service directors and restaurant managers.

Hospital food service directors reported that 62 percent considered the purchase of new energy-efficient equipment to be a cost savings to their fuel bills. The second highest consideration was incineration with heat return representing 38 percent of the facilities.

The energy recovery methods classified as a heat pump or heat exchange system, and recycling heat from cooking and refrigeration equipment, dishmachine, air conditioning, and other systems denoted that 15 percent of hospital food service directors viewed these methods as contributing to a cost savings on energy bills (see Table 10, Appendix A).

One hundred percent of the restaurant managers considered incineration with heat return to be a primary aspect in reducing fuel bills. Recycling heat from cooking and refrigeration equipment, dishmachine, air conditioning, and other systems was the second choice of energy recovery methods considered to be cost beneficial to energy bills (see Table 10, Appendix A). One-third of the restaurant managers viewed a heat pump or heat exchange system as a cost savings to their fuel bills. Thirteen percent of the managers indicated that purchasing new energy-efficient equipment would be beneficial in lowering their energy charges (see Table 10, Appendix A).

The "unknown" group of hospital food services and restaurants denoted that recycling heat from cooking and refrigeration equipment, dishmachine, air conditioning, and other systems would contribute the greatest cost savings to fuel bills. The second highest rated energy recovery method was the purchase of new energy-efficient equipment. A heat pump or heat exchange system was considered third in its cost effectiveness toward energy bills. This group viewed incineration with heat return to be the least plausible means to reduce fuel charges (see Table 20, Appendix A).

Hospital food service directors and restaurant managers showed some perception of the available options to reducing energy bills in the relationship between energy cost savings and recovery methods. Both facilities viewed heat waste recovery as providing the greatest contribution to reducing energy costs.

Energy Conservation Practices

Hospital food service departments and restaurants were asked, via the mail questionnaire, what types of energy conservation measures were used in their facilities. The responses by hospital food services showed that 100 percent conserved energy by reducing food waste through forecasting food production needs; and 77 percent indicated a conservation measure of reducing food waste through portion control. A capital investment of new equipment was viewed as an energy conservation measure by 62 percent of these facilities (see Table 11, Appendix A). Improved efficiency of equipment, such as, using the best capacity load and/or regular maintenance checks was denoted as an energy conservation measure in 54 percent of the facilities. Using less energy-intensive processes by purchasing convenience foods or changing the method of food preparation was viewed as a measure of energy conservation in 23 percent of the facilities. A small percentage of hospital food services reduced energy-consuming activities, specified as not preheating cooking equipment, cooking at lower temperatures or during off-demand times, and use of air curtains for refrigerators and freezers, to conserve energy (see Table 11, Appendix A).

Restaurants reported that reducing food waste through forecasting food production needs was a primary conservation measure in 79 percent of the facilities. Sixty-three percent improved the efficiency of equipment through proper capacity loading and regular maintenance checks as a measure of energy conservation. Reducing energy-consuming activities was denoted as a practice of energy conservation in 46 percent of the facilities. The least applied energy conservation measure was one using less energy-intensive processes, defined as the purchase of convenience foods or changing the method of food preparation (see Table 11, Appendix A).

The "unknown" group of hospital food services and restaurants reported that 100 percent of these facilities used forecasting food production needs to reduce food waste, thereby, conserving energy. Fifty percent of the facilities disclosed that a reduction of energy-consuming activities, specified as not preheating cooking equipment, cooking at lower temperatures or during off-demand times, and use of air curtains for refrigerators and freezers, was used as a conservation measure. Improving the efficiency of equipment was viewed as a conservation measure in 44 percent of these facilities (see Table 11, Appendix A). Portion control to reduce food waste was a practice of energy conservation denoted by one-third of the "unknown" group. Capital investment in new equipment was a means of safeguarding energy reserves in 28 percent of the "unknown" food service facilities. The least used conservation measure was a purchase of convenience foods or change in method of food preparation (see Table 11, Appendix A). Labor time required and number of employees were not significantly affected by the practice of energy conservation measures.

Correlation of Waste Generating Factors to Energy Recycling and Recovery Processes

The Product Moment Correlation technique (Neter et al., 1973) was employed to ascertain the degree of correlation between waste generation in food service facilities and potential energy recycling and recovery possibilities. In this study, the Product Moment Correlation technique permitted a comparison of relationships in the frequencies and distribution among waste generating factors, conservation measures, and recovery possibilities found in hospital food services to those found in restaurants.

On the basis of the questionnaire, the range of correlation between questions C and G, D and G, E and G, and M and N, was divided into a low, medium, and high division for hospital food services, restaurants, and the "unknown" group (see Table 13, Appendix A). Each correlated item was identified according to a low, medium, or high range. The low range of waste generation to energy recycling and recovery was interpreted as having little or no correlation. The medium range presented an intermediary relationship of potential energy alternatives. The high range conveyed a strong correlation between waste generating factors and energy recycling and recovery possibilities.

Through analysis of the highly correlative items, a classification of waste factors to energy recycling and recovery processes was categorized as (1) no payback linked to energy recycling or recovery; (2) fast payback linked to energy recycling or recovery; (3) moderate payback linked to energy recycling or recovery; and (4) long-term payback linked to energy recycling or recovery. A payback period was defined as a return of an amount in profits through full amortization of costs for energy recycling or recovery methods. A fast payback was defined as a time period of 12 to 24 months. A moderate payback specified a period of two to five years. A long-term payback period was defined as a span of time from five to seven years (Anon., 1982).

An estimated payback period for energy cost benefits in food service facilities was contingent on the type of menu and service, hours of operation, training of personnel, and other factors beyond the scope of this study. Therefore, the energy payback periods served as approximate timetables.

Waste to Energy Correlation with Payoff Analysis

Waste generating factors to energy recycling and recovery processes offering no payoff were situations where the waste materials were removed by a commercial disposal service. A fast payoff in energy recovery, through conservation, was seen in the connection between purchasing pre-portioned foods, reducing food waste through portion control, and using less energy-intensive processes. This correlation was disclosed by the "unknown" group of hospital food service departments and restaurants (see Table 12, Appendix A).

Hospital food service departments and the "unknown" group indicated a high correlation between purchasing individually wrapped foods and reducing food waste through portion control. This relationship and rating was interpreted as a fast payoff in energy recovery through conservation. Hospital food services and restaurants, who used glass products and recycled these waste materials, provided a link to a fast payoff with energy recycling possibilities (see Table 12, Appendix A).

The "unknown" group of hospital food services and restaurants indicated that recycling heat from cooking equipment and reducing energy-consuming activities were two processes of recovering energy from heat waste. These indications were interpreted as a fast payoff to energy recovery possibilities. These same facilities denoted a cost savings between recycling heat from cooking equipment and reducing energy-consuming activities (see Table 12, Appendix A). This correlation disclosed a fast payoff through energy recovery.

The Product Moment Correlation technique indicated that the "unknown" group of hospital food services and restaurants viewed a heat pump or heat exchange system as a cost savings in relation to using less energy-intensive processes; namely, the purchase of convenience foods or change in the method of food preparation. This correlation was interpreted as a fast to moderate payoff in terms of investment costs and benefits (see Table 12, Appendix A).

Another correlation made with the "unknown" group was the cost-benefit relationship between a heat pump or heat exchange system as a cost savings, and reducing energy-consuming activities, such as not preheating cooking equipment, cooking at lower temperatures or during off-demand times, and the use of air curtains for refrigerators and freezers.

The correlation of incinerating waste materials in food service facilities to the process of incineration with heat return fell within the high range of correlation among restaurants and the "unknown" group (see Table 12, Appendix A). The waste materials to energy recovery correlation was interpreted as a long-term payoff to the facilities. The "unknown" group of hospital food services and restaurants viewed incineration with heat return, as a cost savings, to be highly correlated with a capital investment of new equipment (see Table 12, Appendix A). The correlation was interpreted as a long-term cost benefit to energy recovery.

Major Decision Factors in the Correlation

Overall, the packaging and market form of food; the service materials and type of utensils; capital investment and maintenance of equipment; and direct or indirect charge for energy usage constituted the major decision factors in the correlation of waste materials in food service to energy recycling and/or recovery possibilities. The correlation analysis, obtained from the mail questionnaire, revealed some situations and views held by hospital food service directors and restaurant managers concerning energy and ways to save on usage and operating costs.

Observation of Food Service Facilities

To examine actual practices of energy recovery and conservation through recycling possibilities, an on-site observation was conducted at two hospital food service departments and three restaurants in Knoxville, Tennessee. Identification of recycled versus nonrecycled waste materials was accomplished by a check list instrument (see Appendix B). A tracking of recyclable food service materials was conducted to supply an estimation of costs and benefits from the recovery or recycling processes.

Recycled versus Nonrecycled Materials

An analysis of the recyclable materials showed that paper, plastic, styrofoam, and metal products were not being recycled in hospital food services and restaurants. These waste materials were removed from the facility by a commercial disposal service to a city landfill located in Knoxville, Tennessee.

Four of the facilities indicated that glass products were washed and reused. Any excess of jars and bottles was discarded with the other waste materials. Under the classification of solid food waste products, it was observed that three facilities reused food trimmings in soups, casseroles, and stews (see Table 14, Appendix A). All five facilities indicated reusing food occurring from overproduction errors. Both of these measures were representative of economical food production practices, rather than, recycling practices. It was found that liquid food waste was not recycled.

Grease products, ranging from liquid and solid shortenings to meat drippings, were found to be recycled in the five facilities (see Table 14, Appendix A). A commercial fat rendering company purchased the used grease products from the hospital food services and restaurants, and recycled these wastes into other usable forms, such as, soap and cosmetic products. The volume of grease products was dependent on the facilities' menu and volume of business.

Waste heat from food production and storage equipment was not recycled in any of the observed facilities. Heat generated from the cooking or storage of food was either vented out of the building, or into the kitchen area. Under the classification of water products, the observations indicated that one facility recycled waste water in the dishmachine through equipment design. The remaining facilities did not recycle their waste water.

Tracking of Recyclable Materials

The recycled materials were tracked at each of the five facilities. The tracking experience was primarily concerned with the method of recycling, and the type of energy used (see Table 14, Appendix A). The volume of waste removed per day provided data for computing an estimated cost benefit return on recycling these materials.

The tracking of materials indicated that options for recycling methods were a limiting factor to the facilities. The practices of reusing the materials, via a wash-and-reuse action, reuse in food production, or sale of waste materials to a commercial recycling firm, indicated the most cost-effective solution for the participating food service facilities.

Cost Analysis Summary for Recyclable Materials

Direct Costs

Cost information for recycling food service materials was estimated by the food service directors and restaurant managers. This information served as an approximation of potential costs related to energy recovery through recycling waste materials in food service facilities.

Total raw food cost for restaurants ranged from 35 to 40 percent of the monthly operating budget. Hospital food service departments maintained an average raw food cost of 39 and 40 percent of their monthly operating budget (see Table 16, Appendix A). Data on the percentage of waste from raw food was not available.

Food waste was estimated on a percentage of total raw food cost per day. Waste from food trimmings and over-production of food was maintained at less than 10 percent in all five facilities. Data on waste volume from plate waste, beverages, cooking liquids, soups, sauces, and gravies was not available. The percentage of waste volume from non-food products, such as paper, plastic, styrofoam, metal, glass, heat, and water was not available (see Table 15, Appendix A).

Cost of labor time, applied to waste removal, was estimated in restaurants at an average starting wage of $3.35 per hour for sixty hours, or $201.00, per month. The estimated labor cost in hospital food services was an average starting wage of $3.60 per hour for 120 hours, or $432.00, per month (see Table 16, Appendix A).

An initial cost of investment for transportation and holding containers was a basis for the cost applied to waste removal. Under the description of "other" cost applied to waste removal, the cost was part of the service charge in the contract with the commercial disposal service. Hospital food service departments were not directly charged for their waste removal (see Table 16, Appendix A). Packaging materials and supplies were restricted to plastic liners for the waste containers. The direct cost applied to waste removal represented an overall average cost per facility. A fluctuation in waste volume was based on the menu and food production schedule for each facility.

Indirect Costs

Indirect costs applied to waste removal were identified as maintenance and repair of equipment, cleaning and sanitation of equipment, storage space for carts and supplies, training of personnel, and a miscellaneous classification including paper plates, cups, and napkins; styrofoam products; plastic products; and Aladdin self-contained thermal trays.

Each classification of costs was itemized for the restaurants and hospital food service departments. Labor time costs applied to the cleaning and sanitation of equipment were calculated at an average starting wage of \$3.45 per hour for 105 hours, or 362.25 per month for both types of facilities. Labor time costs applied to the training of personnel were calculated at an average starting wage of \$4.61 per hour for 240 hours, or \$1,106.40 per month for hospital food service departments. One restaurant manager disclosed that approximately 80 hours of the manager's time was allotted to training of personnel per month. Salary costs were not available from the restaurants. Total indirect costs were calculated separately for restaurants and hospital food service departments (see Table 17, Appendix A).

An estimation of costs and benefits from actual practices of energy recovery and conservation through recycling processes in food service facilities was obtained by on-site observations of restaurants and hospital food service departments. The observations enabled the researcher to substantiate the operators' responses received from the mail questionnaire, as well as, document true practices within these facilities.

CHAPTER 5

SUMMARY, CONCLUSION, AND RECOMMENDATIONS

Summary

An inquiry was conducted to identify the potential for recovering energy through recycling or reusing waste materials in food service facilities in the state of Tennessee. A mail questionnaire and on-site observation instrument were designed to determine whether, and to what extent, recycling of food production waste products existed in food service facilities. An identification of methods for energy recovery through recycling or reuse of production waste materials was obtained from the questionnaire responses and on-site observations and interviews. Approximate costs and benefits were made from the on-site data collection.

Thirteen hospital food service departments, twenty-four restaurants, and eighteen unidentified hospital food services and restaurants responded to the mail questionnaire entitled, Current Energy Practices and Possibilities for Recycling of Materials in Food Service Facilities. Two hospital food service departments and three restaurants participated in on-site observations to examine actual practices of energy recovery through recycling processes. Factors of production waste materials included the type, approximate volume, and market form of food purchased. Types of energy and their consumption costs were estimated from the questionnaire responses.

Hospital food service directors and restaurant managers indicated an awareness of the energy utilization within their facilities. An assessment and identification of energy recovery and recycling practices were gathered from the responses to the questionnaire and observations of the facilities. Energy conservation practices were interpreted as measures of energy recovery or recycling methods. The potential cost effectiveness of energy recovery and recycling methods was correlated with the type of food purchased, approximate volume, market form, and production wastes found in hospital food services and restaurants.

Costs and benefits of recycling waste materials or recovering wasted energy were calculated based on currently used food production methods. An interpretation of fast, moderate, and long-term payoffs was made from the relationship between waste generation, capital investment, and energy savings.

The relationship between waste generation from food production materials, capital investment for energy recovery and recycling purposes, and the realization of energy savings was disclosed through the Product Moment Correlation technique. This method of correlation provided insight to the growing energy concern of hospital food service directors and restaurant managers. Alternative energy recovery solutions, through recycling food production materials, were investigated as cost-effective possibilities for the food service industry.

Waste generation in hospital food service departments and restaurants was produced through the market form of food; and recyclable materials, such as paper, plastic, styrofoam, metal, glass, solid food waste, liquid food waste, grease, heat, and water. The main waste removal method was use of a commercial disposal service. A small percentage of facilities used an incineration process with heat return. The recycling process, as a method of removing waste materials, showed little significance in energy recovery practices in hospital food services and restaurants.

Energy sources were identified and ranked according to type and frequency of use. Electricity was the primary type followed by natural gas and steam. Energy conservation measures were practiced in hospital food services and restaurants. Energy recovery through recycling or reusing waste materials was not widely utilized due to the uneconomical payback period relative to current energy usage and charges.

Grease products were found to be a commonly recycled material through their sale to a commercial fat-rendering company. Glass products were washed and reused. Food trimmings and overproduction of food were reused in soups, casseroles, and stews. Paper, plastic, styrofoam, metal, liquid food waste, heat, and water were not recycled.

Conclusion

Energy recovery and recycling of food production waste materials were explored as possibilities of alternative solutions to today's energy concerns. The concerns of supply reserves and the capability to meet future demands of the food service industry were contingent on energy conservation and recovery through recycling possibilities. The concept of recycling waste materials in food service facilities offered hospital food service directors and restaurant managers an alternative solution to meeting their energy needs.

In relation to recycling or reuse of food production materials, hospital food service directors and restaurant managers indicated a potential for energy recovery through recycling or reusing either the food itself, the packaging material, or the container. Both an interest and concern for these alternative energy solutions were denoted by hospital food services and restaurants. The cost effectiveness of recycling waste materials was an essential factor for both facilities.

In conclusion, the practice of energy recovery through recycling food production materials did exist for specific waste materials in both types of food service facilities. Results from the questionnaire and on-site observations indicated that labor and training costs, equipment, maintenance and supply costs, and capital investment exceeded the dollar benefits from such expenditures.

Hospital food service directors and restaurant managers concurred that energy usage and costs were a vital concern to their operations. It was generally expressed that unless energy supplies were drastically curtailed, the current usage and alternative options would not be cost effective to the facilities.

Recommendations

Conservation remains to offer the greatest prospect of reducing energy consumption, costs, and meeting environmental goals. The food service industry is in a good position to reduce its energy usage through conservation and implementation of energy recovery systems. Energy conservation opportunities were practiced in the hospital food services and restaurants in varying degrees.

This study focused on the opportunities of energy recovery through recycling or reusing food production materials. These materials ranged from packaging materials to food preparation waste to service materials. Package Engineering (Brill, 1981) conducted a survey specifically asking whether the recycling process would become a widely accepted practice by 1983. Brill (1981) found that nearly 50 percent of the respondents indicated that recycling most packaging materials would be accepted. Forty-four percent said "yes" to aluminum recycling, 27 percent for glass, 25 percent for steel, and 13 percent thought plastics would be widely recycled by 1983.

Further research is recommended to determine accurate volumes of selected waste materials in food service facilities that are known to produce usable energy, such as waste heat, paper, metal, and water products. Identification of capital investment costs, energy recovery alternatives, and payback analysis for food service facilities would provide follow-up data to this study. In addition, development of training programs for energy waste accountability in relation to short- and long-term effects on energy usage in food service facilities is suggested.

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APPENDIXES

APPENDIX A

Table 1. Seating Capacity Summary Data for Hospital Food Services and Restaurants

Size	Hospital Food Services		Restaurants		Unknown	
	Frequency	%	Frequency	%	Frequency	%
Less than 50 seats	1	8	5	21	3	17
50 to 99 seats	2	15	8	33	5	28
100 to 149 seats	2	15	2	8	4	44
Over 150 seats	8	62	9	38	6	33

Table 2. Rank, Frequency, and Percentage of Foods Purchased in Volume by Hospital Food Services and Restaurants

Type of Food	Hospital Food Services			Restaurants			Unknown		
	Rank	Frequency	%	Rank	Frequency	%	Rank	Frequency	%
Fresh									
Less than 10%	2	1	8	3	3	13	2	2	11
10 to 29%	1	11	85	1	7	29	1	8	44
30 to 49%	2	1	8	2	5	21	1	8	44
50 to 69%	-	-	-	4	2	8	-	-	-
Over 70%	-	-	-	2	5	21	-	-	-
Frozen									
Less than 10%	3	1	8	2	4	17	-	-	-
10 to 29%	3	1	8	2	4	17	2	5	28
30 to 49%	1	8	62	1	8	33	1	8	44
50 to 69%	3	1	8	4	2	8	3	3	17
Over 70%	2	2	15	3	3	13	4	2	11
Canned									
Less than 10%	3	1	8	2	3	13	4	2	11
10 to 29%	2	4	31	1	8	33	1	6	33
30 to 49%	1	8	62	1	8	33	2	5	28
50 to 69%	-	-	-	-	-	-	3	4	22
Over 70%	-	-	-	3	1	4	-	-	-
Dried									
Less than 10%	1	1	77	1	6	25	2	17	33
10 to 29%	-	-	-	2	1	4	1	18	61
30 to 49%	-	-	-	2	1	4	-	-	-
50 to 69%	-	-	-	-	-	-	-	-	-
Over 70%	-	-	-	-	-	-	-	-	-

Table 3. Rank, Frequency, and Percentage of Market Forms of Food Purchased by Hospital Foods Services and Restaurants

Market Form of Food	Hospital Food Services			Restaurants			Unknown		
	Rank	Frequency	%	Rank	Frequency	%	Rank	Frequency	%
Bulk	2	12	92	1	21	88	1	18	100
Pre-Portioned	2	12	92	2	20	83	3	16	89
Individually Wrapped	1	13	100	2	20	83	2	17	94

Table 4. Rank, Frequency, and Percentage of Type of Tableware Used in Hospital Food Services and Restaurants

Type of Tableware	Hospital Food Services			Restaurants			Unknown		
	Rank	Frequency	%	Rank	Frequency	%	Rank	Frequency	%
China, Glassware, Stainless Steel Utensils	1	13	100	1	16	67	1	9	50
Paper, Plastic, Styrofoam Cups, Paper Plates & Napkins	-	-	-	2	7	29	1	9	50

Table 5. Rank, Frequency, and Percentage of Waste Materials Found in Hospital Food Services and Restaurants

Waste Material	Hospital Food Services			Restaurants			Unknown		
	Rank	Frequency	%	Rank	Frequency	%	Rank	Frequency	%
Paper Products	2	12	92	1	23	96	2	17	94
Plastic Products	2	12	92	3	21	88	2	17	94
Styrofoam Products	1	13	100	1	23	96	2	17	94
Metal Products	1	13	100	2	22	92	2	17	94
Glass Products	1	13	100	4	19	79	4	14	78
Solid Food Waste	2	12	92	1	23	96	3	15	83
Liquid Food Waste	2	12	92	4	19	79	4	14	78
Grease Products	2	12	92	1	23	96	1	18	100
Heat Products	1	13	100	2	22	92	2	17	94
Water Products	1	13	100	2	22	92	3	15	83

Table 6. Rank, Frequency, and Percentage of Waste Removal Methods Used in Hospital Food Services and Restaurants

Waste Removal Method	Hospital Food Services			Restaurants			Unknown		
	Rank	Frequency	%	Rank	Frequency	%	Rank	Frequency	%
Commercial Disposal Service	1	13	100	1	24	100	1	17	94
Incineration	2	4	31	-	-	-	3	2	11
Recycled	3	1	8	2	2	8	2	3	17
Other	3	1	8	2	2	8	4	1	6

Table 7. Rank, Frequency, and Percentage of Energy Sources Used in Hospital Food Services and Restaurants

Type of Energy	Hospital Food Services			Restaurants			Unknown		
	Rank	Frequency	%	Rank	Frequency	%	Rank	Frequency	%
Electricity	1	2	15	1	19	79	1	6	33
Natural Gas	2	1	8	2	11	46	1	6	33
Oil	-	-	-	-	-	-	3	1	6
Steam	2	1	8	4	1	4	3	1	6
Other	1	2	15	3	6	25	2	5	28

Table 8. Percentage Data for Energy Charge Practices in Hospital Food Services and Restaurants

Item	Hospital Food Services % Yes	Hospital Food Services % No	Restaurants % Yes	Restaurants % No	Unknown % Yes	Unknown % No
Directly Charged for Energy Usage	8	92	83	13	50	50

Table 9. Range of Average Monthly Energy Costs Charged to Hospital Food Services and Restaurants

	Average Dollar ($) Charge							
Type of Energy	$15.00-150.00	$151.00-450.00	$451.00-750.00	$ 751.00-1050.00	$1051.00-1550.00	$1551.00-2050.00	$2051.00-2550.00	Over $2551.00
Electricity	1	6	3	6	3	5	3	3
Natural Gas	4	11	2	2	0	0	0	0
Oil	-	-	-	-	-	-	-	-
Steam	1	1	0	0	0	0	0	0
Other	7	0	0	0	0	0	0	0

Table 10. Rank, Frequency, and Percentage of Energy Recovery Methods Considered as a Cost Savings to Fuel Bills in Hospital Food Services and Restaurants

	Hospital Food Services			Restaurants			Unknown		
Energy Recovery Method	Rank	Frequency	%	Rank	Frequency	%	Rank	Frequency	%
Heat Pump or Heat Exchange System	3	2	15	3	8	33	3	4	22
Incineration with Heat Return	2	5	38	1	24	100	4	2	11
Purchase of New Energy Efficient Equipment	1	8	62	4	3	13	2	7	39
Recycling Heat from Cooking and Refrigeration Equipment, Dishmachine, Air Conditioning and Other Systems	3	2	15	2	17	71	1	10	56

Table 11. Rank, Frequency, and Percentage of Energy Conservation Measures Used in Hospital Food Services and Restaurants

Conservation Measure	Hospital Food Services			Restaurants			Unknown		
	Rank	Frequency	%	Rank	Frequency	%	Rank	Frequency	%
Recycling Food Waste Through Forecasting	1	13	100	1	19	79	1	18	100
Reducing Food Waste Through Portion Control	2	10	77	3	12	50	4	6	33
Using Less Energy Intensive Processes	5	3	23	6	5	21	6	4	22
Reducing Energy Consuming Activities	6	2	15	4	11	46	2	9	50
Improved Efficiency of Equipment	4	7	54	2	15	63	3	8	44
Through Capital Investment of New Equipment	3	8	62	5	10	42	5	5	28

Table 12. Rank, Frequency, and Product Moment Correlation of Waste Generating Factors to Energy Recycling/Recovery Processes in Hospital Food Services and Restaurants

Waste Generation to Energy Recycling/ Recovery Processes	Hospital Food Services			Restaurants			Unknown		
	Frequency	%	Product Moment Correlation	Frequency	%	Product Moment Correlation	Frequency	%	Product Moment Correlation
Bulk Foods Purchased/ Waste Materials Recycled	1	8	.083	2	8	.114	3	17	.158
Pre-Portioned Foods Purchased/Waste Materials Recycled	1	8	.083	2	8	.135	3	17	.158
Individually Wrapped Foods Purchased/ Waste Materials Recycled	1	8	.083	2	8	.135	3	17	.108
Pre-Portioned Foods Purchased/Reducing Food Waste Through Portion Control	10	77	.527	12	50	.447	6	33	.250
Pre-Portioned Foods Purchased/Using Less Energy Intensive Processes	3	23	.158	5	21	.229	4	22	.189
Individually Wrapped Foods Purchased Reducing Food Waste Through Portion Control	10	77	.842	12	50	.447	6	33	.171
Individually Wrapped Foods Purchased/ Using Less Energy Intensive Processes	3	23	.158	5	21	.229	4	22	.130
Paper, Plastic, Styrofoam Cups, Paper Plates & Napkins/ Waste Removal by Commercial Disposal Service	N/A	N/A	N/A	7	29	.145	9	50	.243
Paper, Plastic, Styrofoam Cups, Paper Plates & Napkins/ Waste Materials Incinerated	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Paper, Plastic, Styrofoam Cups, Paper Plates & Napkins/ Waste Materials Recycled	N/A	N/A	N/A	7	29	.145	1	6	-.149
Paper Products Used/ Waste Removed by Commercial Disposal Service	12	92	.917	23	96	.673	16	89	-.059
Paper Products Used/ Waste Materials Incinerated	4	31	.192	1	4	.031	2	11	.086
Paper Products Used/ Waste Materials Recycled	1	8	.083	2	8	.063	3	17	.108

Table 12 (continued)

Waste Generation to Energy Recycling/ Recovery Processes	Hospital Food Services			Restaurants			Unknown		
	Frequency	%	Product Moment Correlation	Frequency	%	Product Moment Correlation	Frequency	%	Product Moment Correlation
Plastic Products Used/ Waste Removed by Commercial Disposal Service	12	92	.971	21	88	.886	16	89	-.059
Plastic Products Used/ Waste Materials Incinerated	4	31	.192	3	13	.145	2	11	.086
Plastic Products Used/ Waste Materials Recycled	1	8	.083	2	8	.114	3	17	.108
Styrofoam Products Used/Waste Removed by Commercial Disposal Service	13	100	1.00	23	96	.937	16	89	-.059
Styrofoam Products Used/Waste Materials Recycled	1	8	.083	2	8	.063	3	17	.108
Metal Products Used/ Waste Materials Removed by Commercial Disposal Service	13	100	1.00	2	8	.091	16	89	-.059
Metal Products Used/ Waste Materials Recycled	1	8	.083	2	8	.091	3	17	.108
Glass Products Used/ Waste Materials Removed by Commercial Disposal Service	13	100	1.00	19	79	.845	14	72	-.130
Glass Products Used/ Waste Materials Recycled	1	8	.083	2	8	.155	3	17	.239
Heat Products Used/ Recycle Heat from Cooking Equipment	2	15	.166	10	42	-.025	9	50	.271
Heat Products Used/ Reduce Energy Consuming Activities	2	15	.166	10	42	-.025	9	50	.243
Recycling Waste Materials/Recycling Heat from Cooking Equipment	1	8	-.123	2	8	.193	2	11	.100
Incinerate Waste Materials/ Incineration with Heat Return	2	15	.158	0	0	0	1	6	.437
Purchase of Energy Efficient Equipment/ Improved Operating Efficiency of Equipment	4	31	-.098	2	8	.033	1	6	-.484

Table 12 (continued)

Waste Generation to Energy Recycling/ Recovery Processes	Hospital Food Services			Restaurants			Unknown		
	Frequency	%	Product Moment Correlation	Frequency	%	Product Moment Correlation	Frequency	%	Product Moment Correlation
Heat Pump or Heat Exchange System as Cost Savings/Using Less Energy Intensive Processes	0	0	-.234	2	8	.073	2	11	.357
Heat Pump or Heat Exchange System as Cost Savings/ Reducing Energy Consuming Activities	1	8	.409	6	25	.414	3	17	.267
Purchase of Energy Efficient Equipment as Cost Savings/ Reducing Energy Consuming Activities	2	15	.337	1	4	-.095	3	17	-.114
Recycling Heat from Cooking Equipment as Cost Savings/ Reducing Energy Consuming Activities	1	8	.409	8	33	.038	6	33	.224
Incineration with Heat Return as Cost Savings/Through Capital Investment of New Equipment	4	31	.300	10	42	.192	1	6	.175
Purchase of Energy Efficient Equipment as Cost Savings/ Through Capital Investment of New Equipment	5	39	.025	2	8	.073	1	6	-.240
Recycling Heat from Cooking Equiment as Cost Savings/ Improved Operating Efficiency of Equipment	2	15	.395	10	42	-.118	4	22	-.100
Recycling Heat from Cooking Equipment as Cost Savings/ Through Capital Investment of New Equipment	2	15	.337	6	25	-.201	2	11	-.194

Table 13. Range of Product Moment Correlation for Recycled Materials and Potential Energy Recovery in Hospital Food Services and Restaurants

Degree of Correlation	Hospital Food Services	Restaurants	Unknown
Low	-.231 to .384	-.201 to .371	-.484 to -.094
Medium	.385 to .769	.372 to .744	-.093 to .158
High	.770 to 1.00	.745 to 1.00	.159 to .437

Table 14. Observation of Recyclable Food Service Materials

Category	Description	Frequency of Use: Is Recycled	Frequency of Use: Is Not Recycled
Paper Products	Corrugated boxes		5*
	Cardboard cartons		5
	Paper plates & cups		5
	Paper napkins & placemats		5
	Other		5
Plastic Products	Disposable cups		5
	Plastic knives, forks & spoons		5
	Disposable salt & pepper shakers		5
Styrofoam Products	Disposable cups		2 and 3 NA
	Cushion packaging liners		2 and 3 NA
	Disposable food trays		2 and 3 NA
Metal Products	Aluminum foil and trays		5
	Aluminum cans		5
	Tin cans		5
	Stainless steel		5
	Other		5
Glass Products	Jars & bottles	4 reuse	1
	Glassware	4 reuse	1
	China plates, cups, bowls	4 reuse	1
	Salt & pepper shakers	4 reuse	1
	Other	4 reuse	1
Solid Food Waste** Products		**reuse in production	
	Food trimmings	3	2
	Overproduction of food	5	
	Plate waste		5
	Other		5
Liquid Food Waste Products	Beverages		5
	Leftover cooking liquids		5
	Soup		5
	Sauces and gravies		5
	Other		5
Grease	Liquid and solid shortening	5**	
	Lard		5
**Purchased by a	Vegetable oils	5**	1
commercial fat	Margarine or butter	4	2 NA
rendering	Bacon and/or sausage drippings	3**	2
company	Meat drippings	3**	2
	Other		5 NA
Heat	Steam equipment		2 and 3 NA
	Grill equipment		5
	Ovens and ranges		5
	Food warmers		5
	Refrigerator and walk-in coolers		5
	Freezers		5
	Dishmachine		5
	Ice machine		5
	Other		5
Water	Steam equipment		2 and 3 NA
	Pre-preparation areas		5
	Dishmachine	1	4
	Soiled dish area	1	4
	Pot & pan washing area		5
	Food cart washing area		5 NA
	Other		5

*These numbers represent the five facilities who participated in the on-site observations.

Table 15. Tracking of Recyclable Food Service Materials

Type of Materials	Description	Volume Removed Per Day	Beginning Location	Ending Location	Method of Transportation	Method of Recycling	Type of Energy Used
Glass Products	jars, bottles	NA	storeroom	production & refrigeration	NA	wash & reuse	electricity
	glassware, china	NA	storeroom	dining room & patient service	NA	wash & reuse	electricity
Solid Food Waste	food trimmings & overproduction of food	minimal	production	restaurant & cafeteria	NA	put into soups, casseroles, stews	steam & natural gas
Grease Products	liquid & solid shortening, vegetable oil, bacon, sausage & meat drippings	22.08 lbs. average per facility	storeroom	storage barrel	hand carried	commercial fat rendering company	NA
Water Products	soiled dish area & dishmachine	NA	dishroom	dishroom	NA	cycle through dishmachine	Na

Table 16. Cost Analysis Summary for Recyclable Materials in Food Services--Direct Costs

Description		Total Raw Food Cost %	% Waste of Raw Food	Cost % Applied to Waste Removal
Labor (labor time x rate per hour)	Restaurant	37%, 40%, 35%	NA	* NA, 30%, 30%
	Hospitals	40%, 39%		** 50%, 50%
Food Waste (estimated on percentage of food cost per day)				
Food Trimmings		less than 10%	less than 10%	less than 10%
Overproduction of Food		10%	10%	10%
Plate Waste		NA	NA	NA
Beverages		NA	NA	NA
Leftover Cooking Liquids		NA	NA	NA
Soups, Sauces & Gravies		NA	NA	NA
Other		--	--	--
Non-Food Waste (estimated on percentage of volume removed per day)				
Paper			NA	75-90%
Plastic			NA	10-15%
Styrofoam			NA	5%
Metal Cans/Containers			NA	10%
Glass Jars/Containers			NA	less than 10%
Grease			NA	10-15%
Transport and Holding Containers (initial investment)				
[a]Carts			Hospitals	$7.40
[b]Bins or Garbage Containers			Restaurants	1.03
			Hospitals	2.33
Barrels				NA
Other	Commercial Disposal Service (average monthly charge)		Restaurants	77.00
			Hospitals	NA
Packaging Materials and Supplies				
Plastic Bags				59.28
Cartons				--
Miscellaneous				--
Total Direct Costs (average per month)			Restaurants	$338.31
			Hospitals	493.61

*Labor time for the three restaurant facilities was based on 60 hours per month.

**Labor time for the two hospital food service departments was based on 120 hours per month.

[a]One hundred gallon capacity carts were priced at $222.00 each. The estimated life span of the cart was figured at 5 years or 60 months. It was estimated that hospital food service departments would operate with two carts. The average cost per month for two carts would equal $7.40.

[b]Garbage containers had an estimated cost of $7.00 per container. The estimated life span was figured at 3 years or 36 months. The operational needs for restaurants were established at 5 containers. Hospital food service departments had an average need of 12 containers.

Restaurant costs for garbage containers = 5 x $7.00 = $35.00
Hospital Food Service costs for garbage containers = 12 x $7.00 = $84.00.

Table 17. Cost Analysis Summary for Recyclable Materials in Food Services--Indirect Costs

Description			Cost Applied to Waste Removal
Maintenance and Repair of Equipment (per month)			
(through bills or % time from Maintenance Department)		*Restaurants	$15.00, minimal, NA
		**Hospitals	$316.67, $230.00
Cleaning and Sanitation of Equipment (per month)			
Labor		Restaurants	NA, $402.00, NA
		Hospitals	$402.00, $462.00
		Average for Both	$432.00
Supplies (per day)	Average: $10.34	Restaurants	NA, $16.67, $4.00
	Average: $41.54	Hospitals	$59.75, $23.33
Storage Space for Carts and Supplies			
Cost per Square Foot			NA
Training of Personnel (per month)			
Supervisory Time (labor time x rate per hour)		Restaurants	NA
		Hospitals	$1,135.00 Average: $1,077.60 $1,106.40
Materials and Supplies			NA
Use of Other Supplies (per month)			
Miscellaneous		Restaurants	NA
		Hospitals	$1,561.64 Average: $1,315.07 $1,438.36
Total Indirect Costs (average per month)		***Restaurants	$427.34
		Hospitals	$3,291.64

*Represents the three restaurant facilities.

**Represents the two hospital food service departments.

***The actual indirect costs for restaurants are low due to the unavailable data for storage space for carts and supplies, training of personnel, and miscellaneous supplies.

APPENDIX B

SAMPLE COVER LETTER

We are conducting a research project involving current energy conservation practices and possibilities for recycling materials in food service facilities. The focus will be on potential energy applications to restaurant and hospital food services.

Your assistance in this project will help both of us to evaluate energy alternatives for the future. Therefore, your participation would give strong support to this project.

Knowing your schedule tends to be busy, we have designed the questions for brief and concise answers. All information is strictly confidential.

We would greatly appreciate your completing the enclosed questionnaire and return by February 20, 1982. At the conclusion of the research we will send you an abstract of the findings.

We look forward to hearing from you.

Sincerely,

Mary E. Kopp

Mary E. Kopp
Graduate Student

Mary Jo Hitchcock

Mary Jo Hitchcock, Ph.D.
Food Systems Administration

CURRENT ENERGY PRACTICES AND POSSIBILITIES FOR RECYCLING OF MATERIALS
IN FOOD SERVICE FACILITIES

Your answers to these questions are strictly confidential. Please circle the number or fill in your response(s) to each question.

A. What type or types of food are purchased for your operation?

1 FRESH
2 FROZEN
3 CANNED
4 DRIED

B. What percentage (%) of these foods are purchased?

FRESH

1 LESS THAN 10%
2 10 TO 29%
3 30 TO 49%
4 50 TO 69%
5 OVER 70%

FROZEN

1 LESS THAN 10%
2 10 TO 29%
3 30 TO 49%
4 50 TO 69%
5 OVER 70%

CANNED

1 LESS THAN 10%
2 10 TO 29%
3 30 TO 49%
4 50 TO 69%
5 OVER 70%

DRIED

1 LESS THAN 10%
2 10 TO 29%
3 30 TO 49%
4 50 TO 69%
5 OVER 70%

C. Which form or forms of food are purchased?

1 BULK (such as flour, sugar, meat, eggs, etc.)
2 PRE-PORTIONED (such as meat, poultry, fish, breads, desserts, etc.)
3 INDIVIDUALLY WRAPPED (such as ketchup, mustard, crackers, cereals, jellies, etc.)

D. What type of tableware is used in your operation?

1 CHINA, GLASSWARE, STAINLESS STEEL EATING UTENSILS
2 PAPER, PLASTIC, STYROFOAM CUPS, PAPER PLATES & NAPKINS

E. What is the seating capacity of your dining area?

1 LESS THAN 50 SEATS
2 50 TO 99 SEATS
3 100 TO 149 SEATS
4 OVER 150 SEATS

F. Which of the following materials can be found in your operation?

1 PAPER PRODUCTS (cardboard boxes, liners, dinnerware, etc.)
2 PLASTIC PRODUCTS (cups, glasses, knives, forks, spoons, etc.)
3 STYROFOAM PRODUCTS (cups, food trays, etc.)
4 METAL PRODUCTS (aluminum foil/cans, tin cans, stainless steel, etc.)
5 GLASS PRODUCTS (jars, bottles, glassware, china, etc.)
6 SOLID FOOD WASTE (food trimmings, leftover food, plate waste, etc.)
7 LIQUID FOOD WASTE (soups, sauces, gravies, cooking liquids, beverages, etc.)
8 GREASE PRODUCTS (liquid & solid shortenings, vegetable oils, meat drippings, etc.)
9 HEAT PRODUCTS (steam, electricity, gas, etc.)
10 WATER PRODUCTS (pre-preparation & steam equipment, dishmachine, etc.)

G. How are these materials removed from your facility?

1 COMMERCIAL DISPOSAL SERVICE
2 INCINERATED (burned)
3 RECYCLED
4 OTHER, EXPLAIN ________________

____

GO TO OTHER SIDE

H. If a commerical disposal service removes these materials, what are your costs?

1 $________ PER LB.

2 $________ PER LOAD

3 $________ OTHER, EXPLAIN ____________ ____________

I. What income do you receive from selling any of these materials?

1 THIS OPERATION DOES NOT RECEIVE ANY DOLLARS FROM THE SALE OF THESE MATERIALS

2 $________ PER ___ OF ________

J. How often are these materials removed from your facility?

1 THREE TIMES A WEEK

2 TWO TIMES A WEEK

3 ONCE A WEEK

4 OTHER, EXPLAIN __________ ____________

K. Is your operation directly charged for the energy it uses?

1 NO

2 YES

L. What was your average monthly cost for utilities during 1981?

1 $________ ELECTRICITY

2 $________ NATURAL GAS

3 $________ OIL

4 $________ STEAM

5 $________ OTHER, EXPLAIN ____________

M. What energy recovery methods would you consider to be a cost savings to your fuel bills?

1 HEAT PUMP OR HEAT EXCHANGE SYSTEM

2 INCINERATION (burning) WITH HEAT RETURN

3 PURCHASE OF NEW ENERGY EFFICIENT EQUIPMENT

4 RECYCLING HEAT FROM COOKING & REFRIGERATION EQUIPMENT, DISHMACHINE, AIR CONDITIONING, AND OTHER SYSTEMS

N. What types of energy conservation measures do you use in your operation?

1 REDUCING THE AMOUNT OF FOOD WASTE (accurate forecasting & food production)

2 REDUCING THE AMOUNT OF FOOD WASTE (buying pre-portioned products/ portion control)

3 USING LESS ENERGY-INTENSIVE PROCESSES (purchasing convenience foods, changing the method of food preparation)

4 REDUCING ENERGY CONSUMING ACTIVITIES (not preheating cooking equipment, cooking at lower temperatures or during off-demand times, use of air curtains for refrigerators & freezers)

5 IMPROVED OPERATING EFFICIENCY OF EQUIPMENT (using the best capacity load and/or regular maintenance checks)

6 THROUGH CAPITAL INVESTMENT OF NEW EQUIPMENT (cooking units, refrigeration and/or freezer units, timers, and/or modification of facility)

O. Did your conservation measures affect any of the following phases of the operation?

1 FOOD QUALITY AND/OR SAFETY EXPLAIN ____________________

2 NUMBER OF EMPLOYEES REQUIRED

3 LABOR TIME REQUIRED IN HOURS

4 CUSTOMER OR PATIENT SERVICE

P. A team will be conducting a survey of selected food service facilities to identify energy recovery/conservation opportunities. All facilities who participate in the survey will receive a report of the survey findings in their facility.

Would you be willing to have your facility surveyed?

1 NO

2 YES

3 MAYBE

If YES or MAYBE, please indicate the name of facility, contact person, and telephone number.

NAME OF FACILITY __________________

CONTACT PERSON __________________

TELEPHONE NUMBER __________________

PLACE IN ENVELOPE. RETURN BY MAIL.

SECTION A

Observation of Recyclable Foodservice Materials

Section A covers materials that are presently recycled or not recycled.
Section B is an energy tracking procedure for the identified recyclable materials.

Category	Description	Frequency of Use Is Recycled	Frequency of Use Is Not Recycled
Paper Products	Corrugated boxes		
	Cardboard cartons		
	Paper plates & cups		
	Paper napkins & placemats		
	Other		
Plastic Products	Disposable cups		
	Plastic knives, forks & spoons		
	Disposable salt & papper shakers		
Styrofoam Products	Disposable cups		
	Cushion packaging liners		
	Disposable food trays		
Metal Products	Aluminum foil and trays		
	Aluminum cans		
	Tin cans		
	Stainless steel		
	Other		
Glass Products	Jars & bottles		
	Glassware		
	China plates, cups, bowls		
	Salt & pepper shakers		
	Other		
Solid Food Waste Products	Food trimmings		
	Overproduction of food		
	Plate waste		
	Other		
Liquid Food Waste Products	Beverages		
	Leftover cooking liquids		
	Soup		
	Sauces and gravies		
	Other		
Grease	Liquid and solid shortening		
	Lard		
	Vegetable oils		
	Margarine or butter		
	Bacon and/or sausage drippings		
	Meat drippings		
	Other		
Heat	Steam equipment		
	Grill equipment		
	Ovens and ranges		
	Food warmers		
	Refrigerator and walk-in coolers		
	Freezers		
	Dishmachine		
	Ice machine		
	Other		
Water	Steam equipment		
	Pre-preparation areas		
	Dishmachine		
	Soiled dish area		
	Pot & pan washing area		
	Food cart washing area		
	Other		

SECTION B

Tracking of Recyclable Food Service Materials

Type of Material	Description	Volume Removed Per Day	Beginning Location	Ending Location	Method of Transportation	Method of Recycling	Type of Energy Used

Cost Analysis Summary for Recyclable Materials in Food Services

Direct Costs

Description	Total Raw Food Cost %	% Waste of Raw Food	Cost % Applied to Waste Removal
Labor (labor time x rate per hour)			
Food Waste (estimated on percentage of food cost per day)			
Food Trimmings			
Overproduction of Food			
Plate Waste			
Beverages			
Leftover Cooking Liquids			
Soups, Sauces & Gravies			
Other			
Non-Food Waste (estimated on percentages of volume revoed per day)			
Paper			
Plastic			
Styrofoam			
Metal Cans/Containers			
Glass Jars/Containers			
Grease			
Transport and Holding Containers (initial investment)			
Carts			
Bins or Garbage Containers			
Barrels			
Other			
Packaging Materials and Supplies			
Plastic Bags			
Cartons			
Miscellaneous			
Total Direct Costs			

Cost Analysis Summary for Recyclable Materials in Food Services

Indirect Costs

Description	Cost Applied to Waste Removal
Maintenance and Repair of Equipment (through bills or % time from Maintenance Department)	
Cleaning and Sanitation of Equipment Labor	
Supplies	
Storage Space for Carts and Supplies Cost per Square Foot	
Training of Personnel Supervisory Time (labor time x rate per hour)	
Materials and Supplies	
Use of Other Supplies Miscellaneous	
Total Indirect Costs	

VITA

Mary E. Kopp was born on October 12, 1951 in Moline, Illinois. She graduated from Alleman High School in June, 1969. From September 1969 until August 1971 she attended Black Hawk College where she completed her freshman and sophomore years of college. She transferred to the University of Wisconsin-Stout in Menomonie, Wisconsin where she earned a bachelor of science degree in Dietetics in May, 1973. In October 1974 she completed her dietetic internship at Henry Ford Hospital in Detroit, Michigan. She became a registered dietitian in 1975.

From 1974 until 1978 she was employed as a clinical dietitian in the hospital setting. During the span of years from 1976 to 1978 she worked for the Stouffer Corporation, Management Food Service Division, in clinical and administrative positions. She completed one year of graduate study in the Department of Institution Management at Iowa State University where she was employed as a graduate teaching assistant from 1978 to 1979. She has been employed six months as a graduate teaching assistant in the Nutrition and Food Sciences Department of the College of Home Economics at The University of Tennessee, Knoxville.

Mary is the daughter of Elizabeth C. Kopp and the late Eugene L. Kopp.